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## **Airborne Laser (ABL): Issues for Congress**

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# Airborne Laser (ABL): Issues for Congress

## Summary

The United States has pursued a variety of missile defense concepts and programs over the past fifty years. Since the 1970s, some attention has focused on directed energy weapons, such as high-powered lasers for missile defense. Today, the Airborne Laser (ABL) program is the furthest advanced of these directed energy weapons and remains the subject of technical and program debate.

The Department of Defense (DoD) has been a strong advocate for the ABL and its predecessor programs. The Defense Department and most missile defense advocates argue that the ABL, which is designed to shoot down attacking ballistic missiles within the first few minutes of their launch, is a necessary component of any future U.S. missile defense system. Although some observers have suggested additional roles for the ABL, such as attacking other airborne or even ground targets, the Missile Defense Agency (MDA) maintains it is necessary to concentrate on developing the ABL's primary mission to engage and destroy attacking ballistic missiles before ancillary roles can be considered. Congress has largely supported the Administration's ABL program.

Funding for the ABL began in FY 1994, but the technologies supporting the ABL effort evolved over 25 years of research and development concerning laser power concepts, pointing and tracking, and adaptive optics. Currently, the ABL program is set to conduct a lethality test in 2005. Assuming a successful test, the Defense Department has stated that this test platform could then be made available on an emergency basis in a future crisis. To date, about \$2.1 billion has been spent on the ABL program; the Administration foresees spending an additional \$4.4 billion over the FYDP (Future Years Defense Plan). Total program costs are not available because the system architecture has not been defined.

Program skeptics have raised several issues. Their questions include the maturity of the technologies in use in the ABL program and whether current technical challenges can be surmounted. If the ABL is proven successful, there have been questions about the number of platforms the United States should acquire. Seven aircraft have been mentioned previously, but is this number appropriate? What stresses might continued ABL program slippage or delays place on the supporting industrial base? How does the ABL compare to alternative concepts, such as Unmanned Aerial Vehicles or Boost-Phase Interceptors? To what degree should the United States invest in alternative technologies in the event that the ABL may not prove successful? Finally, how might the results of the upcoming lethality test and other systems integration tests influence decisions about the use of the ABL test platform in a future crisis?

This report examines the ABL program and budget status. It also examines some of the issues raised above. This report does not provide a detailed technical assessment of the ABL program (see CRS Report RL30185, *The Airborne Laser Anti-Missile Program*). This report will be updated as necessary.

## Contents

Introduction .....	1
System Overview .....	3
Program Status .....	5
Issues for Congress .....	6
Technology and Program Challenges .....	6
Concept of Operations (CONOPS) .....	8
Industrial Base Issues .....	9
Lethality Test and Contingency Capability Issues .....	10
Alternatives to the ABL .....	11

## List of Tables

ABL Budget Request & Appropriations (\$million) .....	6
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# Airborne Laser (ABL): Issues for Congress

## Introduction

The United States has sought to develop and deploy missile defenses for more than 50 years. Since President Reagan's Strategic Defense Initiative (SDI) in 1985, the United States has spent at least \$78 billion on missile defense programs and studies. National missile defense (NMD) has proven to be challenging and deployment of an effective NMD system has been elusive. NMD has been a divisive political and national security issue. Debate has focused on the nature and immediacy of foreign missile threats to the United States and its interests, the pace and adequacy of technological development, the foreign affairs and budgetary costs of pursuing missile defenses, and implications for deterrence and global stability.

In the mid-1980s and into the early 1990s, Congress reacted to these concerns and questions by reducing requested missile defense budgets and providing legislative language to guide the development of missile defense programs and policy.

During this time, many in Congress appeared more concerned than the Defense Department and the military about near-term threats to forward-deployed U.S. military forces posed by shorter range ballistic missiles. Congress demonstrated those concerns by supporting the development and deployment of theater missile defenses (TMD),<sup>1</sup> oftentimes over the objections of the Defense Department. Since the end of the 1991 Persian Gulf War, and especially over the last several years, Congress generally has supported larger missile defense budgets. Currently, the FY2004 request of \$9.1 billion for all DoD missile defense programs is the largest Defense Department program; this year's funding request has been approved by the House and Senate.<sup>2</sup>

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<sup>1</sup> Theater missile defenses are anti-missile systems designed to destroy or deflect an attacking short-range ballistic missile from reaching its intended target. Those early TMD programs strongly supported by Congress in the mid-late 1980s included the Israeli Arrow program and the Patriot ATM (anti-tactical missile) system used in the Persian Gulf war.

<sup>2</sup> For a broad treatment of missile defense issues see Steven A. Hildreth (coordinator), *Missile Defense: The Current Debate*, CRS Report RL31111, updated regularly.

The primary technological concept for missile defense since the early 1980s<sup>3</sup> has been ‘hit-to-kill’ interceptor missiles,<sup>4</sup> but other alternatives have also been pursued. One is the development of laser technology and the platforms on which lasers might be based. For most missile defense advocates the Airborne Laser (ABL) program represents the most promising near-term effort. Although the Air Force contends that the ABL is mature technology, some observers have questioned whether this technical assessment is accurate, pointing out that the various ABL components have yet to be fully integrated and tested. Considerable debate also continues over whether the ABL will be capable of dealing with likely future ballistic missile threats.<sup>5</sup>

The effort that led to the ABL dates to the early 1970s when the Air Force began development of an Airborne Laser Laboratory (ALL) — a modified KC-135A aircraft — to demonstrate that a high-powered laser mounted on an aircraft platform could destroy an attacking missile. After ten years of research, development, and field testing (from 1981-1983) the ALL program announced that lasers had managed to “destroy or defeat” five Sidewinder air-to-air missiles and a simulated cruise missile<sup>6</sup> at short range. The ALL aircraft was retired in 1984 because its research purpose was considered no longer necessary.

Although the ALL test targets were not ballistic missiles, the Air Force and the Defense Department became increasingly interested in the possibility of using high-powered lasers aboard aircraft to destroy enemy ballistic missiles during their boost phase.<sup>7</sup> Through the 1980s and mid-1990s, further research on various ground laser concepts and designs and tracking and beam compensation tests convinced Pentagon

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<sup>3</sup> Prior to the early 1980s, the United States had pursued missile defense concepts that largely employed nuclear-tipped missile interceptors, because a high degree of accuracy was not required. More recently, conventional explosive warheads were used to develop the Patriot PAC-2 system used in the 1991 Persian Gulf War. Advanced and exotic concepts, such as various lasers, are now being considered.

<sup>4</sup> A kinetic kill interceptor would seek to destroy its intended target through a direct collision at relatively high speeds. The force of the impact would then destroy the attacking missile or warhead, render it inoperable, or divert it from its intended target. With such an approach, however, a near-miss has the same practical affect as a large distance miss — the target is not destroyed.

<sup>5</sup> There is considerable on-going technical debate outside of government regarding ballistic missile countermeasures, and the design or procedural measures by which an adversary might seek to defeat or mitigate missile defenses. See especially the recent report by the American Physical Society: *Report of the American Physical Society Study Group on Boost-Phase Intercept Systems for National Missile Defense: Scientific and Technical Issues*, July 2003.

<sup>6</sup> Michael Davey and Frederick Martin, *The Airborne Laser Anti-Missile Program*, CRS Report RL30185, February 18, 2000, p. 4.

<sup>7</sup> The Defense Department defines the boost-phase as that portion of the flight of a ballistic missile or space vehicle during which the booster and sustainer engines operate. This can last up to several minutes. During this time, a ballistic missile is relatively large and vulnerable — its rocket engine plume makes the ballistic missile highly visible, the missile is under tremendous pressures, and it is slower relative to later portions of the flight trajectory.

officials to proceed with the conditional development of the ABL in June 1998 (although low-level funding for the program began as early as FY 1994). More recently, the ABL program became part of the Missile Defense Agency's (MDA) Air-Based Boost program.<sup>8</sup> The ABL's lethality test demonstration, which is designed to test the various subsystems and target a ballistic missile, has been delayed and is currently scheduled for sometime in 2005.

Congress has funded the development of missile defenses in the face of growing concerns about the proliferation of missiles around the world. Of all the current efforts, missile defense advocates believe the ABL shows the best near-term promise for destroying enemy ballistic missiles during their boost-phase. While still in the earth's atmosphere, the airborne laser would seek to rupture or damage the missile's booster skin to cause the missile to lose thrust or flight control and fall short of the intended target before decoys, warheads, or submunitions are deployed. The expectation is that this would occur near or even over the enemy's own territory. Second, although the United States has primarily pursued kinetic energy kill mechanisms for missile defense for the past twenty years, most defense analysts believe that if the United States chooses to pursue increasingly effective missile defenses for the longer term future, then alternative concepts such as high-powered lasers may be the answer.

This report tracks the current program and budget status of the Airborne Laser program. In addition, this report examines several related issues that have been of interest to Congress. It will be updated as necessary. This report does not provide a technical overview or detailed assessment of the ABL or Air-Based Boost Program; for that analysis see *The Airborne Laser Anti-Missile Program*, CRS Report RL30185, February 18, 2000.

## System Overview

It is envisioned that the ABL would use a high-powered chemical laser mounted in a bulbous turret on the front of a modified Boeing 747 aircraft to destroy or disable enemy theater ballistic missiles during the initial portion or first several minutes of their flight trajectory (from shortly after launch and before they leave the earth's atmosphere). Analysts indicate that during this period (up to several minutes) the missile is at its most vulnerable stage — it is slower relative to the rest of its flight, it is easier to track because the missile is burning its fuel and thus has a very strong thermal signature, and it is a much larger target because any warhead has not yet

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<sup>8</sup> Because the ABL's predecessor — the ALL — came under the Air Force's Space and Missile Systems Center (SMC), the ABL at first also came under the responsibility of the SMC. After a prototype model was completed, ABL personnel management functions were transferred to the Air Force's Aeronautical Systems Center (ASC) in 2001 (both SMC and ASC are under the Air Force's Materiel Command, based at Wright-Patterson AFB, Ohio). Also in 1991, ABL funding and program management was transferred to BMDO (the Ballistic Missile Defense Organization, which was MDA's precursor organization). ASC is responsible for ABL's personnel and MDA is responsible for program execution or carrying out the program.

separated from the missile itself. Analysts also point out the advantages of destroying the missile before any warhead, decoys, or submunitions are deployed, and potentially over the enemy's own territory.

To date, the ABL program has put a weapons-class chemical laser aboard a modified Boeing 747-400 series freighter aircraft (747-400F). The Air Force acquired the 747-400F in January 2000 directly from the Boeing Commercial Aircraft assembly line and flew it to Wichita, Kansas, where Boeing workers virtually rebuilt the aircraft. Among other things, they grafted huge sheets of titanium to the plane's underbelly for protection against the heat of the laser exhaust system, and added a 12,000-pound bulbous turret on the plane's front to house the 1.5 meter telescope through which the laser beams would be fired. This plane made its maiden flight in July 2002; it logged 13 more flights in 2002 before relocating to Edwards AFB California for the integration and testing of the weapon system components, and awaiting the 2005 lethality test.

Major subsystems include the lethal laser, a tracking system, and an adaptive optics system. The kill mechanism or lethal laser system (as distinct from the other on-board acquisition and tracking lasers) is known as COIL (Chemical Oxygen Iodine Laser). COIL generates its energy through an onboard chemical reaction of oxygen and iodine molecules. Because this laser energy propagates in the infrared spectrum, its wavelength travels relatively easily through the atmosphere. The acquisition, tracking, and pointing system (also composed of lasers) helps the laser focus on the target with sufficient energy to destroy the missile. As the laser travels to its target, it encounters atmospheric effects that distort the beam and cause it to lose its focus. The adaptive optics system compensates for this distortion so that the lethal laser can hit and destroy its target with a focused energy beam.

In November 1996, the Air Force awarded a \$1.1 billion PDRR contract (Program Definition Risk Reduction phase) to several aerospace companies. The contractor team consists of Boeing, Lockheed Martin, and Northrop Grumman (formerly TRW). Boeing Integrated Defense Systems (Seattle, WA) has overall responsibility for program management and systems integration, development of the ABL battle management system, modification of the 747 aircraft, and the design and development of ground-support subsystems. Lockheed Martin Space Systems (Sunnyvale, CA) is responsible for the design, development, and production of ABL target acquisition, and beam control and fire control systems. Northrop Grumman Space Technology (Redondo Beach, CA) is responsible for the design, development, and production of the ABL high-energy laser). A number of subcontractors are also involved.

It is envisioned that a fleet of some number of ABL aircraft would be positioned safely behind the forward line of friendly troops and then moved closer toward enemy airspace as local air superiority is attained. The Defense Department has indicated that a fleet of five aircraft might support two 24-hour combat air patrols in a theater for some unspecified period of time in a crisis.



## Program Status

The current ABL development and acquisition strategy is described in terms of several ‘blocks’. The primary goal for ABL Block 2004 is to demonstrate a lethality kill. The projected demonstration has been rescheduled several times in recent years and is now scheduled for 2005 (MDA’s best estimate at this point is January 2005). A number of other flight and system tests are envisioned as well. The ABL test platform consists of a half-power laser that the Defense Department states could be available for deployment in an emergency immediately after the lethality test (assuming a successful test demonstration). Block 2006 would seek to expand the capability of this ABL system and improve its interoperability with other systems and platforms. For example, more stressing scenarios are envisioned, including firing against different and multiple ballistic missiles. As part of this Block, requirements will be reviewed for operational deployments overseas.

The objective of Block 2008 is to incrementally build on ABL’s capabilities, fully integrate the ABL into DoD’s missile defense acquisition strategy, produce a second ABL test platform (basically an assessment aircraft for any production decisions that could be used in an emergency as well), and work on issues such as affordability and increased laser lethality. The Missile Defense Agency has described Block 2008 as something different than the former EMD (Engineering, Manufacturing, and Development) ABL program pursued by the Clinton Administration. They argue the new program is a capabilities-based approach using less-advanced technology and involving less schedule risk. Finally, Block 2010 + would introduce and integrate new technologies into the ABL program and seek to integrate the ABL boost-phase concept with the rest of U.S. missile defenses.

Currently, because of the acquisition strategy adopted by MDA for missile defenses, the total ABL program cost cannot be given or estimated. Nor has the final system architecture been identified, meaning that the total number of ABL aircraft has not been determined. Prior to adopting this new evolutionary acquisition or “spiral development” strategy,<sup>9</sup> however, there were some indicators of what the Pentagon envisioned. In its FY1997 Annual Report to Congress, DoD’s Office of Test and Evaluation envisioned seven ABL aircraft for a total program cost of \$6.12 billion (then year dollars). The most recent cost estimate, from the Clinton Administration, was \$10.7 billion (life-cycle costs) for the same number of aircraft.

Since FY1994, Congress has largely supported the ABL program by appropriating the Defense Department’s requests, which have totaled about \$2.15 billion. See table below, which shows the President’s Budget (PB) request and the amount Congress appropriated. For FY2004, the Bush Administration requested about \$610 million for the ABL program. Currently, both the House and Senate have passed appropriations bills that fully fund the Administration’s request.

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<sup>9</sup> See Gary Pagliano and Ronald O’Rourke, *Evolutionary Acquisition and Spiral Development in DOD Programs: Policy Issues for Congress*, CRS Report RS21195, updated June 3, 2003.

## ABL Budget Request & Appropriations (\$million)

FY	'94	'95	'96	'97	'98	'99	'00	'01	'02	'03	'04
PB	1.90	20.00	19.95	56.83	157.14	292.22	308.63	148.64	410.00	597.97	610.04
App.	1.90	20.00	19.95	54.28	157.14	276.22	308.63	233.64	483.5	597.97	

## Issues for Congress

Several factors combine to affect the near future of the ABL program. First, the ABL continues to face technical challenges. Second, in January 2002, the MDA dropped the traditional requirements-setting process in favor of a “capabilities-based” approach, intended to more quickly field a system capable of responding to some, if not all of the current ballistic missile threat. Third, on June 13, 2002, the United States withdrew from the Anti Ballistic Missile (ABM) Treaty, thus removing numerous barriers to potential anti-missile platforms. Fourth, the MDA is exploring alternatives to the ABL for the Boost Phase Intercept (BPI) mission. Finally, recent changes in funding profiles for both the ABL and for the MDA’s new kinetic kill vehicle reinforce the uncertainty related to the ABL program. Specific issues that may confront Congress include the severity and implications of the ABL programmatic and technological challenges, how the ABL might be employed if and when it is fielded, the potential for industrial base problems, the scheduled lethality test, and consideration of boost-phase alternatives to the ABL.

## Technology and Program Challenges

As a new type of weapon system, the ABL has faced technological challenges throughout its history.<sup>10</sup> The GAO has pointed out the challenges of developing and fielding a new type of weapon system, when it noted that “only one of the ABL’s five critical subsystems, the aircraft itself, represents mature technology.”<sup>11</sup> In October 1997 the GAO issued a report (GAO/NSIAD-98-37) highlighting the program’s technical challenges and calling them “significant.” In 2001, DoD’s Director of Operational Test and Evaluation called the ABL a “high technical risk” program and outlined a number of technical challenges to be overcome.<sup>12</sup>

There is some consensus on the ABL’s current technical challenges. In congressional testimony, the GAO pointed out that the ABL program office agreed with its assessment of the technological maturity and technical challenges in most

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<sup>10</sup> See CRS Report RL30185 for a more comprehensive assessment of the ABL’s technical challenges.

<sup>11</sup> *Defense Acquisitions: Assessments of Major Weapon Programs*. General Accounting Office. May 2003. GAO-03-476. P.18.

<sup>12</sup> Laura Colarusso. “DOT&E Says ABL Faces Major Challenges: Lethality Test Postponed.” *Inside the Air Force*. March 1, 2002.

instances; only disagreeing about the adaptive optics' maturity and challenges.<sup>13</sup> However, consensus appears to break down when evaluating how these challenges might affect budget and schedule. The GAO asserts that "problems with maturing technology have consistently been a source of cost and schedule growth throughout the life of the program."<sup>14</sup> But, the ABL program's new requirements setting process, and its focus on developing a less sophisticated system based on currently available technology, may result in less risk of cost and schedule growth in the future.<sup>15</sup> The Missile Defense Agency asserts that recent program adjustments have put the program on budget and schedule.

Two technical issues have long challenged the ABL program: adaptive optics and system integration.<sup>16</sup> The essentials of these two challenges have not changed that much in recent years.

The ABL system's weight has become a more recent concern, however. The ABL was designed to carry 14 laser modules that were planned to weigh a total of 175,000 lbs. The six laser modules produced thus far already exceed this weight budget by at least 5,000 lbs.<sup>17</sup> ABL officials have replaced the cargo variant of the 747-400 with the passenger variant to better position the laser modules, but weight problems persist.<sup>18</sup>

On the weight gain issue, ABL proponents admit that the laser modules are currently too heavy. However, they argue that the requirement is for the whole weapon system to fit within the 747's maximum takeoff weight — 800,000 lbs, and that they are not far from meeting that objective.<sup>19</sup> ABL critics disagree, arguing that if the laser modules are too heavy, the airplane will carry fewer of them, which will result in a reduced laser power. A weaker laser, in turn, could require the ABL to fly closer to its targets to achieve the same level of lethality as the stronger laser, which could in turn reduce the aircraft's survivability. ABL proponents say that if the laser module weight cannot be decreased, the power from the lasers could be increased to

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<sup>13</sup> Statement of Robert E. Levin. Testimony Before the Subcommittee on National Security, Veterans' Affairs and International Relations, Committee on Government Reform, House of Representatives. July 16, 2002. GAO-02-949T.

<sup>14</sup> GAO-03-476. P.18.

<sup>15</sup> Robert E. Levin *OpCit* and GAO-03-476. P.18

<sup>16</sup> See Dan Morgan and Michael Davey, *The Airborne Laser Anti-Missile Program*, CRS Report RL30185, for an in-depth treatment of the adaptive optics and systems integration challenges.

<sup>17</sup> Gopal Ratman and Gail Kaufman. Pentagon Works to Solve ABL's Weight Gain." *Defense News*. March 3, 2003. p.6. Some press accounts assert that the 6 laser modules are 25,000 lbs over the weight budget. Marc Selinger. "Airborne Laser on Track Despite Weight Gain, Official Says." *Aerospace Daily*. March 7, 2003.

<sup>18</sup> The module is a major building block for the megawatt-class laser subsystem. The laser power outputs from all six modules will be combined to produce the missile-destroying laser beam.

<sup>19</sup> Thomas Duffy. "ABL Officials Looking for Answers to Weight Distribution Problem." *Inside Missile Defense*. November 27, 2002.

improve lethality, or the 747 could carry less fuel which would free up more of the weight budget for heavier lasers. ABL critics doubt that laser module power could be boosted more than 20 percent of their current output, which is not enough to compensate for the more than 50 percent reduction in the number of modules due to weight.<sup>20</sup> Also, they argue, if the ABL carries less fuel, it will require more aerial refueling to perform its mission, and recent military operations in Afghanistan and Iraq suggest that DoD's aerial refueling fleet is already overburdened.

ABL officials say that they believe the program's technical challenges are being overcome.<sup>21</sup> However, MDA's FY04 R&D request for a common boost- and mid-course interceptor suggests that MDA may have some doubts about the ABL's ultimate success. As described by Senate authorizers, the \$301.1 million requested for the Common Interceptor represents a six-fold increase in funding for this technology.<sup>22</sup> Some argue that such an increase in an alternate boost phase technology program suggests that MDA is seeking at least a hedge or perhaps even a replacement for the ABL if it fails or proves ineffective. Officially, the MDA touts the interceptor's commonality rather than its possible use as an ABL alternative. For instance, MDA Director Air Force Lt. Gen. Kadish told reporters that the agency finds the common interceptor attractive because "given that we no longer have the constraints of the [1972 Anti-ballistic Missile] treaty and the way the services have put together operational requirements documents . . . I think it is now possible to think and actively pursue commonality that makes sense and a common interceptor with a common type of kill vehicle."<sup>23</sup>

## Concept of Operations (CONOPS)

Another group of ABL questions that may confront Congress pertains to the aircraft's concept of operations, or CONOPs. As the program nears procurement and potential fielding, questions remain about the number of aircraft to be procured, where the aircraft might be deployed, and how they would be used.

The most recent plans called for the procurement of seven ABL aircraft. A number of questions are likely to be asked regarding this planned inventory. A force of this size could be expected to provide 24-hour TBM BPI coverage of one theater. Past doctrine and current real-world events suggest that U.S. interests could be threatened simultaneously in more than one theater and by more than one country with TBMs. Would seven aircraft be sufficient to adequately address potential threats? To address growing deployment requirements and to improve personnel

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<sup>20</sup> Ratnam and Kaufman, *OpCit*.

<sup>21</sup> Marc Selinger. "Airborne Laser on Track Despite Weight Gain, Official Says." *Aerospace Daily*. March 7, 2003.

<sup>22</sup> National Defense Authorization Act for Fiscal Year 2004. Committee on Armed Services. United States Senate. Report 108-46 (S. 1050). May 13, 2003. p.236. This program is proposed to develop an interceptor missile that can be either ground- or sea-based, for boost and mid-course phase intercept of ballistic missiles.

<sup>23</sup> Thomas Duffy. "Boeing to get Follow On Work for Common Missile Interceptor." *Inside Missile Defense*. September 18, 2002.

retention, the Air Force has organized itself into 10 Air Expeditionary Forces (AEFs) that rotate on predictable schedules. How would a force of seven ABLs support the 10 AEFs? The Air Force, and other Services, frequently complain about the onerous and disproportionate O&S (Operations and Support) costs of “high demand, low density” (HD/LD) assets such as JSTARS and U2s. Would procurement of only seven aircraft create another HD/LD problem for the Air Force? On the other hand, buying more aircraft would require more people to fly and maintain them.

It is currently unclear what impact the ABL might have on the Air Force’s already strained aerial refueling fleet. While based at some yet-to-be determined U.S. base, ABLs will likely deploy to forward operating locations such as Guam, Diego Garcia, RAF Fairford England, and Elmendorf AFB Alaska during crises. Although these bases are likely closer to tomorrow’s hot spots than the continental United States, they are still hours of flying time away from the Persian Gulf, the Korean Peninsula, and Central Asia. ABLs will require refueling to get to the crisis theater, refueling to maintain combat air patrols in-theater, and refueling to return to base. What effect will the ABL’s current weight gain have on its fuel load? Might increased payload mean less fuel and therefore an even greater aerial refueling requirement?

Some observers have questioned how the ABL would be employed to counter intercontinental ballistic missiles (ICBMs). The consensus is that Russia and China currently field ICBMs that could plausibly threaten the United States; there is no such consensus on the future ability of North Korea or other so-called “rogue states” to field such missiles. (Some believe that such capabilities will emerge in the distant future, if ever. Others see the proliferation of such missiles as inevitable, and that it could occur sooner rather than later.) Current estimates suggest that the ABL’s 400 km range (about 250 miles) is too short to stand outside Russian or Chinese airspace and still engage those countries’ ICBMs in boost phase. Would the ABL fly into these countries’ airspace during crisis to address potential ICBM launches in boost phase? Or would the ABL’s laser need to be more powerful? Or will some alternative be deployed to supplement or replace the ABL for these scenarios?

It appears that ABL CONOPS questions are also affected by MDA’s decision to abandon the traditional requirements process. MDA has adopted a “flexible” requirements process that is driven as much by technological maturity as it is by operator needs. Thus, it is difficult to assess how the ABL might be employed because it is not currently clear what the ABL’s capabilities will be, once fielded.

## **Industrial Base Issues**

A final set of issues revolves around the ABL industrial base. Missile defense officials have cautioned that the ABL is pursuing very specialized technologies that are not routinely pursued in civilian or even defense industries. Turbulence in ABL funding or schedule, they maintain, jeopardizes the ABL industrial base because these specialized vendors will seek other business if ABL business appears threatened. The industrial base supporting advanced optical components of the ABL

is most frequently cited as “fragile.”<sup>24</sup> The criticality of these vendors to the health and progress of the ABL program has not been clearly established. DoD may, or may not, for example, find expertise in the optical telecommunications industry that would be applicable to ABL needs. Once the health of the ABL-specific contractor and subcontractor base has been established Congress may be asked to help preserve some of the “critical path technologies” that enable the ABL. If this take place, a key calculation to make may be the break point at which keeping a number of specialized companies in business outweighs the potential value of fielding the ABL.

## **Lethality Test and Contingency Capability Issues**

The lethality test now scheduled for 2005 (possibly January 2005) is seen as a critical next step in the ABL program’s development. The objectives of this test include:

- ! to demonstrate an actual shoot-down of a missile over the Pacific Ocean, possibly a Scud missile;
- ! to test the IRST (the Infrared Search & Track System), to see if the ABL can find, hold and track the intended target; and
- ! to demonstrate that the adaptive optics systems is able to compensate for atmospheric distortion.

The lethality test is important for a number of reasons, many of which have to do with the long advocated potential for this ABL test aircraft for emergency or contingency missions immediately after the lethality test. First, the test will demonstrate whether or how well the various ABL subsystems and component parts are working together. The fact that this test has been delayed several times and for several years now, suggests to some that continued systems integration problems are forcing this delay. Depending on the test results, additional system integration tests may be required. If significant technical problems arise or additional technical challenges are identified, the availability of this ABL platform for near-term emergency missions would likely be questioned.

Second, depending on the nature and outcome of the lethality test itself, use of this ABL test aircraft may not be appropriate in an emergency or contingency mission. For instance, if the lethality test fails to hit or destroy a Scud or other ballistic missile, military planners may not want to rely on a test aircraft deployed during a crisis. Additionally, if the lethal test is not considered significant (for example, the test is conducted against a very short range missile at very close range), military planners similarly may not have confidence in actually using the ABL test platform during a crisis. Some in the ABL program have suggested that the platform could be made available only as a airborne sensor and for battle management purposes. Others have questioned whether meaningful testing protocols can be developed if the ABL system is not yet integrated.

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<sup>24</sup> See, for example, Testimony of LtGen. Ronald Kadish, Director, Missile Defense Agency. Hearing Before the House Armed Services Committee, Military Procurement Subcommittee. June 27, 2002.

Once the ABL resumes flying, some 35-50 other missions are planned to validate design and other changes; additional air refueling missions are being considered. During the flight tests, this ABL test aircraft will operate with a relative large contingent of personnel, including two aircrew and up to 16 others monitoring various system elements. Test missions are expected to last 4-8 hours. Flight testing will occur at three ranges, but primarily Edwards AFB. The ABL will also fly to the Army's White Sands Missile Range, NM. The attempted missile shoot-down will take place over the Pacific Missile Range.<sup>25</sup>

## Alternatives to the ABL

These programmatic and technological challenges lead to another family of questions regarding the ABL's current and potential standing in missile defense vis-a-vis other missions and platforms. Might other platforms offer promise in the theater Boost Phase Intercept mission area?

With their long endurance and increasing payloads, Unmanned Aerial Vehicles (UAVs) may one day offer alternatives to the ABL. UAVs have been studied as BPI platforms since the mid-1990s. At the time, a UAV-based Boost Phase Intercept approach was viewed as a back-up to ABL in case that program encountered difficulties. Congress provided \$15 million in FY96 for a joint U.S./Israeli advanced concept technology demonstration (ACTD) program to study the feasibility of using up to 20 UAVs with three to six lightweight missiles each to conduct BPI in an Iraq-like scenario.<sup>26</sup>

The Army Space and Strategic Defense Command estimated that the 20-UAV architecture could cost \$1.5 billion over a 10-year life span, compared to a then-estimated \$6 billion 10-year life cycle cost for the ABL and a \$17 to \$23 billion 10-year life cycle cost for a space-based laser.<sup>27</sup> In addition to potentially lower cost, possible UAV advantages include the ability to operate closer to theater ballistic missile (TBM) launch points than the ABL, and the ability to conduct the BPI mission without endangering the lives of aircrews. Perceived UAV deficiencies include a lack of adequate payload carrying capability. Considering the rapid recent advances in UAVs and their operational success, however, some analysts believe it may be time to revisit the UAV-based approach and weigh its efficacy relative to the ABL program. In the mid 1990s, the Air Force also studied outfitting F-15s with special air-to-air missiles to destroy TBMs in boost phase. Some in Congress have expressed their preference for UAVs over manned aircraft in this role. In its report (S.Rept. 104-112/S. 1026), the Senate Armed Services Committee wrote that "to the extent that kinetic-energy BPI systems hold promise for TMD applications, the

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<sup>25</sup> Robert Wall, "Debugging ABL." *Aviation Week and Space Technology*. September 1, 2003, pp. 55-56.

<sup>26</sup> "Congress Provides \$15 Million in FY-96 for Joint U.S.-Israel BPI Program." *Inside Missile Defense*. December 20, 1995.

<sup>27</sup> Pamela Hess. "USAF Questions Army Plan to Use UAVs for Boost-Phase Intercept Mission." *Inside Missile Defense*. October 11, 1995.

committee believes that reliance should be placed on unmanned aerial vehicles (UAVs).”

Some constraints on ship-based missile defenses have been eliminated by the Bush Administration’s decision to withdraw from the 1972 ABM treaty. Ship-based systems are attractive to missile defense planners because ships often can be maneuvered close to hostile areas. A number of BPI experiments are planned for FY2004 combining modified Standard anti-aircraft missiles with the Kinetic Kill Vehicle (KKV).<sup>28</sup>

Although platforms other than the ABL might conduct TMD BPI, it is also possible that the ABL might be capable of performing additional or alternative missions. When in charge of the program, the Air Force studied alternative roles for the ABL including cruise missile defense, destroying or disabling enemy satellites, or intercepting high altitude surface-to-air missiles. In November 2002, the Air Force Scientific Advisory Board recommended that the Air Force also consider using the ABL to attack time critical targets on the ground.

Today, the only alternative — albeit similar — role that MDA is considering for the ABL is BPI of intercontinental ballistic missiles (as opposed to theater-range ballistic missiles). MDA officials state that they need to concentrate on developing the ABL’s technology to conduct its primary mission of theater ballistic missile defense before ancillary roles can be considered. Others may question whether abandoning the assessment of alternative uses for the ABL is prudent. Congress has appropriated about \$2.1 billion for the ABL thus far, and DoD plans to request about \$4.44 billion over the FYDP. Some are likely to maintain that more should be done to investigate potential returns on this investment. The ABL is DoD’s most mature high power chemical laser program. If MDA determines that UAVs or ship-based KKV offer more potential in TMD BPI, studying alternative uses for the ABL might be a way to exploit the advances made by the program.

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<sup>28</sup> Thomas Fuddy. “Study to Define Candidates for Sea-Based Boost-Phase Interceptor.” *Inside Missile Defense*. May 29, 2003.